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Solar Radiation and the 27-day Interval

By Dr. C. CHREE, F.R.S.

AS various attempts have been made to correlate with meteorological results the daily measures of solar radiation obtained by Dr. Abbot and his collaborators, the significance of these measures is of interest to meteorologists. The difficulties in the observations and their reduction are considerable. The attitude of physicists varies from that of the man willing to accept the third place of decimals in every daily measure, to that of the man sceptical as to any sensible variation from one day to the next. But, accepting the figures provisionally as absolutely exact, there are various possible explanations. They might signify variations in absorption due to some unknown cause but common to the whole of the earth's atmosphere, or the varying presence of some absorptive medium external to both earth and sun. They might arise from varying absorption in the solar atmosphere, or from a difference in the radiation of the sun in different directions. Owing to the solar rotation, the face presented to the earth is constantly varying, so that if different zones differed in their emission—even if the total radiation were constant—we should anticipate variation in the radiation received by the earth. There is strong evidence that different zones do exhibit such a difference in the case of the ionic radiation, supposed responsible for magnetic disturbances on the earth. It is now, I think, generally believed that there is a decided tendency in magnetic conditions on the earth, whether quiet or disturbed, to show a 27-day interval, and the

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most natural explanation is a difference in the radiation from different solar zones, which possesses a similar degree of persistence to that exhibited by sunspots. It thus appeared desirable to find out whether a 27-day interval was recognizable in the Abbot figures. An opportunity for doing this is afforded by the appearance in the *Meteorologische Zeitschrift* for November, 1922, of daily measures* of the solar radiation for 1919 and 1920, which are supposed to be comparable amongst themselves.

Following the same procedure as for magnetic disturbance, I selected for each month the five days of largest, and the five days of lowest radiation. There being no data for 1921, December 1920 was omitted, leaving 115 days representative of high, and 115 days representative of low radiation. The radiation figures for the 115 days of high radiation were entered in a column headed n. There were similarly entered in columns headed $n + 26$, $n + 27$ and $n + 28$, the radiation figures from the associated days which were respectively 26, 27 and 28 days subsequent to the selected days of high radiation. A similar procedure was followed for the 115 selected days of low radiation and the subsequent days associated with them. There were no radiation data for a good many days, so that the associated day results available in the several columns fell considerably short of 115, varying indeed from 87 to 95. Mean results were obtained, as a matter of fact, for each individual month, but in several months only one or two associated days were available. As the radiation figures showed no marked annual variation, a mean which assigned equal weight to each day seemed preferable to one which assigned equal weight to each month. The mean radiation values thus obtained were as follows :—

	n	$n+26$	$n+27$	$n+28$
Days of high radiation and associated days ...	1.969	1.949	1.945	1.946
Days of low radiation and associated days ...	1.923	1.952	1.948	1.950

The mean value of solar radiation for the 24 months was 1.948. When equal weight was allotted, not to each day but to each month, the figures obtained were nearly identical with the above. In 1919 the associations of low radiation with *high* radiation on the 26th day thereafter were decidedly above expectation. But the phenomenon did not repeat itself in 1920, so it is presumably accidental. At any rate there is no suggestion of any tendency

* The entries in the table in question appear to be the mean values for the day of the estimates of the "Solar Constant" made at Calama, Chile. The figures are taken from the *U.S. Monthly Weather Review*, Feb. 1919, *et seq.*, and Aug. 1921.—Ed.M.M.

for high or low radiative values to repeat themselves after a 27-day interval. In the case of magnetic disturbance, it may be added, the 27-day interval showed its presence in 1919 and 1920 to a normal extent, so that the years presumably were not abnormal.

It remains to call attention to a rather remarkable difference between 1919 and 1920. The mean values of solar radiation from all the observations, allowing equal weight to each month, were almost identical, being 1.947 for 1919 and 1.948 for 1920. But the mean values from the 60 selected days of high radiation and from the 60 selected days of low radiation were respectively 1.965 and 1.929 for 1920, as against 1.973 and 1.918 for 1919. There was thus apparently a very large reduction in the variability of radiation in the later year. Assuming this not to be due to any reduction in the uncertainties of observation, it suggests a greater uniformity in solar radiation as we approach sunspot minimum.

Solar Radiation at South Kensington: 1913-1920

BY L. C. W. BONACINA

THE inauguration of solar radiation observations by means of such instruments as the Callendar radiograph and the Ångstrom pyrheliometer has marked the beginning of the scientific study of an important climatological element, namely, the intensity of radiation received at a place from the sun. Clearly, ordinary sunshine records tell one nothing of the quality and intensity of the sunshine, while " temperatures in the sun " merely indicate the temperature of the thermometer exposed to insolation and ought not to be quoted in climatology.

Having had occasion, recently, to study the Callendar Recorder observations at South Kensington for the octad 1913-1920 as published in the annual volumes of the *Geophysical Journal* I have compiled the following tables for the various months. Table A gives the means for the eight years of the total daily amounts of radiation received by a horizontal surface expressed in joules per square centimetre and Table B gives the means of the daily maximum " intensities " expressed in milliwatts per square centimetre. The joules and milliwatts are given to the nearest whole number.

The months are put in the order of the mean values, a space being left to separate the solstitial from the equinoctial periods.

A Joules per cm². 1913-1920 (8 years).				B Milliwatts per cm². 1913-1920 (8 years).	
June	1553			June	75
May	1487	Summer.		July	70
July	1306			May	69
August	1193			August	66
April	986			April	58
September	909	Equinox.		September	53
March	591			March	40
October	485			October	35
February	325			February	24
November	227	Winter.		November	19
January	164			January	15
December	130			December	12

It will be seen that with the single exception of the interchange* between May and July in Table A the months are arranged in the exact order of their astronomical positions according to length of day and altitude of the sun at noon.

In a climate like England where the meteorological "sunniness" or percentage of the possible duration varies in the same sense as the astronomical "sunniness" or amount possible, *i.e.* the length of the day, the actual amount of sunshine must necessarily be very much greater round the summer solstice than round the winter solstice; and if the above tables had been based on a long period, say 30 years, one could have foreseen that the months would be arranged exactly according to length of day. But the fact that, with the single exception noted above, the same arrangement holds for so short a period as eight years is quite remarkable, showing that in this climate the variable meteorological factors affecting the monthly transparency or diathermancy of the atmosphere are small in comparison with the dominating geometrical factors which make the amount of radiation received horizontally from a high sun greater than that from a low sun.

Of the individual months of the whole 96, June, 1914, heads the list both for A and B values, with 1706 and 78 respectively, a fact which substantiates a vivid impression I received that year to the effect that the sun-heats of that month were excep-

* This anomaly between May and July also appears in the 5-year period 1914-1918 which I first examined. The addition of three more years to the record has greatly accentuated this, evidently because the Mays of 1913, 1919 and 1920 were all characterized by brilliant weather, while the Julys were all meteorologically dull. It will be most interesting to see whether the anomaly vanishes ultimately as the record lengthens.

tionally intense even for June—often, too, on days when the air temperature was relatively low. At the bottom of the list comes the cold and gloomy December of 1916, with 109 joules and 11 milliwatts. One wonders how this would compare with the appalling December of 1890 !

In order to see how the June of 1914 compares with the extremely brilliant period May-July, 1921, the corresponding figures for these three months, which are just available, were examined with the following interesting result :—

	A Values.	B Values.
June, 1914	1706	78
May, 1921	1483	79
June, 1921	1728	80
July, 1921	1656	78

It is thus seen that the June of 1914 was beaten by the June of 1921, but not by July, 1921—a month with a rather higher total duration of sunshine and a much higher mean temperature. Evidently the month of June, by reason of its position at the high solstice, is very difficult to oust from its premier position for intense sun-heats.

I have also examined for Kew the Angström radiograph results for the five years 1914-1918, but means cannot be given owing to the fact that daily observations were not taken. Nevertheless the maximum intensities expressed in milliwatts per square centimetre, relatively few as they are, bear out exactly what one would expect, namely, that the relation to the solstices and equinoxes with an instrument that received the radiation perpendicularly is much less close than is the case with the Callendar instrument, and also that the differences between the summer and winter values are smaller. In this case, too, at a different place, the highest figure, 86 milliwatts, is shown for June, 1914 ; but if daily observations had been taken the superiority of this month might have stood out still more clearly. Of the three factors which affect the intensity of radiation received upon a horizontal surface, namely—(1) angle of incidence, (2) thickness of atmosphere traversed, (3) transparency or diathermancy of the atmosphere, the first is eliminated with the Angström instrument so that the influence of factor (3) is more obtrusive. Obviously one June can only differ from another June in virtue of factor (3) if one assumes that the " solar constant " really is constant in the two cases.

For general climatological purposes it is, of course, the results for horizontal surfaces that ought to be studied.

The significance of the remark made above that the apparent power of the sun in June, 1914, was very great, even on cool days, is that the apparent power of the sun to human sensation

is influenced to a large extent by the temperature of the air, which consequently ought to be allowed for in making comparative estimates by physiological means. But if one takes a day in June with 80° F. air-temperature and one in September with the same temperature, then, provided both days have the same amount of wind and humidity and are equally transparent to the sun's rays, the sun on the June day must necessarily feel hotter to any one in the open. Similarly a hot day of 90° F. is a fiercer affair, say, in Italy than an equally hot day as judged merely by the air temperature in England.

The moral, therefore, is to remember that the full thermal aspects of climate involve something more than temperatures; and that in making comparisons between temperatures in different latitudes, at different altitudes and at different times of the year, regard ought to be paid to the direct income of solar heat for which a scientific method of study has now been found. It should be remembered, however, that the Callendar radiograph does not register the dark rays to which the glass bulb is not transparent.

[It should be noted that the measurements quoted in this Article may require correction owing to changes in the calibration of the instruments. The Kew results are discussed in a paper to be published shortly as a *Geophysical Memoir*—ED.*M.M.*]

Toy Balloon "Races" from Brighton

BY HY. HARRIES

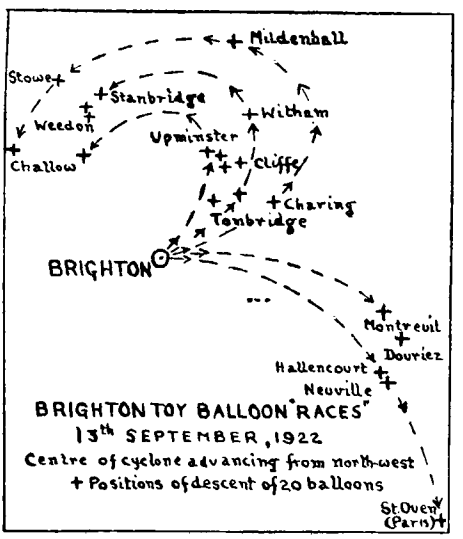
IN the November number of this magazine (p. 281) mention was made of toy balloon races organized by Major MacLulich, at Brighton, during last summer. At first the venture was regarded merely as a mild form of sport, the longest distance flown being the only consideration in awarding the prizes, so that no account was taken of the time at which a balloon left Brighton. Many travelled into Germany and Denmark, the distance "made good" exceeding 400 miles in several instances, in one case reaching 465 miles.

On August 23rd (hour not stated) a young man and his fiancée each selected a balloon, and these were liberated simultaneously. Both were picked up at St. Marcel par Vitrey, Haute Saône, on the 24th, by the same person, one at 6h., the other "in the morning," so that the two had travelled in company 295 miles in a direction S 51° E.

Early in September I suggested to Major MacLulich to give the date and hour of departure on the cards; and on the 9th of

the month, under well-marked anticyclonic north wind conditions numerous balloons were liberated, and as many as 43 cards were returned, all from the north of France, north of the 48th parallel, and between longitudes 1° E and 1° W. The wind must have been very steady in direction, for nearly all the balloons followed a course between S 2° E and S 5° E.

Ten of the balloons were picked up in the afternoon of the day of their departure from Brighton, one within 2½ hours, having travelled 108 miles, or at a rate exceeding 43 miles per hour, and one within four hours, covering 143 miles. The balloons had thus attained an altitude where the wind was of gale velocity.



Of more interest were the flights of balloons despatched on September 13th. On this day a well-defined cyclonic system was advancings south-eastward across the midland counties, directly towards Brighton.

Many balloons were liberated, and the cards of 20 of them were returned. Projected on a map, showing the time of ascent and the destination of each, the results are curious as well as interesting, because, while 15 balloons were drawn into the cyclonic whirl, five were carried outside, into north-eastern France.

Two sent off at 11h. 30m. reached Essex (Grays and Witham); three at 11h. 40m. reached Essex (Brentwood), Suffolk (Mildenhall), and away round to Berks (Challow); three at 11h. 45m. reached Essex (Upminster) and Bucks (Stanbridge and Weedon); six at noon reached Pas de Calais (Montreuil sur Mer and Douriez), Kent (Charing and Maidstone), Bucks (Waddesdon), and Berks (Twyford); one at 12h. 30m. and another at 13h. reached Kent (Tonbridge and Cliffe at Hoo); three at 15h. passed to Paris (St. Ouen), the Somme (Neuville aux Bois), and Bucks (Stowe); and an untimed one crossed over to the Somme (Hallencourt).

The International Section of the *Daily Weather Report*, No. 22,211, contains no observations showing the upper wind over our south midland counties, but we can picture the routes followed by the balloons, which, after passing over East Anglia curved round in the northern side of the cyclone, four descending in north Bucks, and two continuing south-westward, crossing the Thames into Berks.

There is in the *Daily Weather Report* information affording an explanation of the travel of the five balloons which crossed over to France. From south-west on the Sussex coast, the surface wind veered to west at Dungeness, and at Amiens the upper winds were west, 13 miles per hour at 1,640 feet, west-north-west, 18 miles per hour, at 3,280 feet, and north-west, 22 miles per hour, at 4,000 feet, so that four balloons appear to have ascended into the west-north-west current, the one which descended at Montreuil sur Mer having been picked up four hours after its ascent, having made 76 miles, direction S 74 E, or 19 miles per hour, an excellent agreement with the Amiens observation. The balloon which dropped at St. Ouen must have ascended into the north-westerly wind, making 148 miles S 40° E. The Montreuil balloon was the only one picked up on the same day as the ascent, so that 19 cases afford no clue to the rate of travel.

It will be noticed that of the three balloons despatched at 15h. one descended in Thatcham Park, Stowe, Bucks, and another at St. Ouen, the positions being 226 miles apart, from north-west to south-east.

During the second half of the month the holiday season waned, so that subscribers to the races decreased, and from the flights after that of the 13th only about two dozen cards were returned. Of these six had travelled the short distance to the Somme and Pas de Calais on the 16th.

A similar experience to that of August 23rd occurred on September 21st. The evening air was so calm that two balloons liberated at the same instant made, in company, a perpendicular ascent until lost to sight in a thin misty cloud at an estimated altitude of about 2,000 feet. Their cards showed that within 12 hours of their despatch both were picked up in the streets of Cassel, Germany, on the 22nd, one at 6h. 30m. the other at 7h., having made 365 miles N 85° E, or 30 miles an hour. Another balloon sent off about a quarter of an hour earlier drifted very slowly eastward across the West Pier and descended at Littlestone-on-Sea, Dungeness.

As an interesting parallel to [the two cases cited by Mr. Hy. Harries of balloons liberated together falling in the same town or village, it may be mentioned that in 1914 two registering balloons sent up from Benson on consecutive days were both picked up in the little parish of Lode, Cambridgeshire (see *Geophysical Journal*, February, 1914). It is equally difficult to explain such coincidences and to accept them as merely accidental.

Discussions at the Meteorological Office

February 19th, 1923. *A theory of meteors, and the density and temperature of the outer atmosphere to which it leads.* By F. A. Lindemann, F.R.S., and G. M. B. Dobson, M.A. (Proc. Roy. Soc. A. Vol. 102, 1922, pp. 411-437.)

Opener—Captain N. K. Johnson.

It has long been a reproach to meteorologists that they have hardly taken cognizance of the phenomena from which their science derives its name. It seems to have been left to Professor Lindemann and Major Dobson to point out that the density of an atmosphere which can heat up a meteor charging into it with an assigned velocity until it volatalizes should be determinable with considerable accuracy. The authors have not only set the problem, but solved it. The results are of great interest. The data on which their investigation is based may be summarized as follows (they refer to a typical meteor) :—

Height of first luminosity	100 *km.*
Height of disappearance	80 *km.*
Length of path	60 *km.*
Speed	40 *km. per second.*
Apparent luminosity at 150 km. from the observer	*First magnitude star.*

On the assumption that practically all the energy sent out from the star is luminous, it follows that :—

The rate of emission of energy = 3·3 *kilowatts.*

Moreover, if this energy, emitted at the rate of 3·3 kilowatts for 1½ seconds, represents the kinetic energy of a body moving at 40 km. per second, the mass of the body must be very small, in fact :—

The mass of the typical meteor = 6 *milligrams ;*

and

The diameter is therefore of the order ... 1 *millimetre.*

The temperature of the volatalizing meteor is estimated at about 2,000 *a* (*say*, 3,000° *F.*).

The meteor is enabled to reach this temperature of volatalization owing to the concussion with the molecules of the atmospheric gases. It is the merit of the paper that, by showing how the accumulation of heat during this process is associated with the mass of atmosphere which is passed through, it provides a means of computing the density of the atmosphere. There are three lines of attack. All lead to the result that the upper atmosphere is much denser than has been supposed hitherto. At 150 kilometres it is 1,000 times as dense as had been computed on the assumption of a uniform temperature of 220 *a* (−63·4° F.) from 10 kilometres upwards.

It follows that this assumption must be seriously in error, and

we learn to our surprise that the true temperature of the outer atmosphere from 50 to 150 km. is about 300 *a* (say, 80° F.), *i.e.*, comparable with that of the earth's surface. A tentative explanation of the paradox is forthcoming, namely that the atmosphere at the levels in question is rich in ozone. Ozone absorbs the ultra violet light from the sun, and this absorption, which is responsible for the poor development in the ultra violet in our sunlight, is thought to suffice to warm the outer shell.

Captain Johnson pointed out a few weaknesses in the mathematical development of the subject, but Professor Lindemann, who took part in the discussion, laid stress on the fact that, whereas modifications in the argument might lead to estimates of density differing by 100 per cent., the discrepancy between the new results and the assumption of a uniform temperature of 220 *a* amounts to at least 10,000 per cent.

March 5th, 1923. *The pilot charts of the South Atlantic and South Pacific* (U.S. Hydrographic Office).

Opener—Sir David Wilson Barker.

The many naval men who were present at this discussion bore witness to the value of these charts. There was, however, a concensus of opinion in favour of an atlas of charts rather than the periodical issue of charts for separate months on flimsy paper. It was announced that there is a likelihood of the British charts being published in such an atlas. As to the detail, a preference for our own methods of shewing winds and sea currents was expressed.

On March 19th, 1923, Captain C. J. P. Cave will open a discussion on M. Louis Besson's *Classification détaillée des nuages à l'Observatoire de Montsouris* (Ann. des Services Techniques d'Hygiene de la ville de Paris, 1921). This will be the last discussion of the session. The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these discussions. Those who would like to receive notices of the meetings next session should make application now.

News in Brief.—From the Aerological Observatory at Pavlowsk, which is now under the directorship of M. P. A. Moltchanoff, the first number of a new monthly publication (in Russian), entitled *Results of daily investigations of the free atmosphere*, has been received. The results of observations taken by means of kites, pilot balloons or aeroplanes, are given for each day of January, 1923. The heights attained are not generally great, but the regularity with which the ascents are carried out and the prompt circulation of the observations are noteworthy. It is interesting to see that the Gregorian Calendar is now adopted, at least for meteorological purposes, in Russia.

Royal Meteorological Society

THE monthly meeting of the society was held on Wednesday, February 21st, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair.

The reform of the calendar.

A discussion on the reform of the calendar, with special reference to recent proposals by Dr. C. F. Marvin, Chief of the Weather Bureau of the United States, was opened by Lieut.-Col. E. Gold, F.R.S. Colonel Gold devoted some time to the historical aspect of the question before considering the specific scheme put forward by Dr. Marvin. This scheme involves the division of the year into 13 months of 28 days each and Colonel Gold pointed out that the substitution of the prime number 13 for the many factored number 12 would be most inconvenient, as the grouping of the monthly figures to give statistics for the halves or quarters of the year would no longer be practicable. A further objection, that the traditional characters of the months would be seriously altered if any were shifted by as much as two weeks towards the beginning or end of the year, was raised by Mr. Bonacina. The proposal to take one day from August and add one day to February and so restore the symmetry destroyed by the vanity of the Emperor Augustus is understood to be within the sphere of practical politics and this proposal met with the approval of the speakers. For Dr. Marvin's plan there was no encouragement.

Dr. S. Fujiwhara—On the growth and decay of vortical systems and *On the mechanism of extratropical cyclones.*

Captain D. Brunt gave an account of the contents of these two papers. In the first Dr. Fujiwhara describes experiments which indicate that, in water, vortices with the same sense of rotation attract whilst vortices rotating in opposite senses repel each other. He traces the growth of vortices by amalgamation as a kind of animate growth, and adduces evidence to show that cyclones and anticyclones can be regarded as following similar laws.

In the second paper an equation devised by Hesselberg and Friedmann for the determination of the rate of change of the vorticity of horizontal motion in the earth's absorption is discussed, and it is shown that the most important source of energy of a cyclone is to be found in the vorticity of the surrounding fluid. The production of cyclones along the polar front is shown to be capable of explanation as the absorption by a larger whirl of the horizontal whirl which forms at the surface.

These papers are by no means easy to follow but those who had devoted most time to their consideration were the most enthusiastic in their admiration for the ideas embodied in them.

Correspondence

To the Editors, *The Meteorological Magazine*

A Lunar Rainbow

AT 10 p.m. on February 22nd a beautiful lunar rainbow was seen here spanning the Downs. The bow, perfectly formed against a background of stormy cloud, stood north and south, each end terminating in the sea. Beneath the pallid, mysterious arch was the Pier, vague and shadowy, and the dim shapes and lights of vessels out in the Channel. The moon, in a patch of clear sky, rested peacefully " upon her back " in the west, while a gusty wind from a southerly direction carried a heavy rain-squall rapidly seaward.

The arch was visible for a few minutes and then began to fade, rifts appeared in the gloomy cloud curtain, stars shone in the wind-swept spaces, and the Goodwin and Calais lights once more flashed over the heaving waters. It was an arresting and striking phenomenon, and may have heralded the thunderstorm that followed later in the night.

ARTHUR BUTCHER.

31, *Beach Street, Deal, February 24th*, 1923.

[In another account of this rainbow it is referred to as " quite white, like two powerful searchlights side by side." The fact that the eye does not perceive the colour of faint lights is well known ; the luminosity of the rainbow is but a small fraction of that of the moon itself.—ED. *M.M.*]

The Fata Morgana

IN the " Notes and Queries " of the February issue of this magazine (page 12) I notice a reference to the Fata Morgana with a query respecting the connection of the name with King Arthur's sister. The following quotation from *Ancient Man in Britain*, by Donald A. Mackenzie (Blackie, 1922) page 161, may throw some light on the matter, as well on the Scottish name " Margaret the Orkney Witch ":—

> " In Greece the pearl was called margaritoe, a name which survives in Margaret, anciently the name of a goddess. The old Persian name is margan. It is possible that this is the original meaning of the name of Morgan le Fay [Morgan the Fairy] who is remembered as the sister of King Arthur, and of the Irish goddess Morrigan " [probably both are the same deity]. . . . " In Italian we meet with Fata Morgana."

The writer is referring to the wide-spread use of pearls as charms. Morgana is a prominent figure in the Charlemagne romances, and in one tale uses her mirage to deceive the paladin Orlando. The subject is well worth investigation.

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, February 26th*, 1923.

The Design of Rain-Gauges

I WAS pleased to see Mr. Mace's letter correcting the misprint in his letter published in the December magazine, as the mis-statement puzzled me considerably. I had continued observations with a low-rim gauge, after setting up beside it one of the Snowdon pattern, for the years 1914-1921, and my experience was similar to his, viz., that a higher rainfall and more rain days were recorded by the former. The figures for the two gauges were published each year in *British Rainfall*. I also contributed a note to this magazine in 1919 with regard to some summer showers not giving sufficient water in the gauge to be measured, in which I suggested, as Mr. Mace does, that the surface of the funnel to be wetted influences the amount of rain recorded.

A. E. SWINTON.

Swinton House, Duns, Berwickshire, January 1923.

[This correspondence raises the question whether it is the object of the rain-gauge to accumulate dew. Remembering that there is no reason to suppose that the amount of dew which is deposited on vegetation is the same as that deposited on a rain-gauge covering an equal area (indeed, much of the "dew" on vegetation is exuded from the plant itself), it seems better to exclude dew as far as possible from our measurements and to regard the collection of a certain amount as merely a necessary evil. That being so, the gauge with the protecting cylinder has the advantage in that dew is mostly deposited on the outside of the cylinder, comparatively little dew will be derived from the pocket of stagnant air inside the cylinder, and a good deal of that evaporates in the morning and never reaches the container.

As to the loss by evaporation of the rain-drops which fail to run down the funnel before it is thoroughly wetted, it must be admitted that the shallow gauge has the advantage. This is a small matter, however, in comparison with the serious defects of such a gauge, its incapacity to retain snow and hail and its almost complete failure in windy situations.—ED. *M.M.*]

Low Barometer Readings

ON Monday, February 26th, a very deep depression, accompanied by a strong south-westerly gale, and a good deal of rain, passed over southern Ireland. My barometer (reduced to sea level) registered 28·10 in. This is the lowest I have ever recorded since I commenced observations in 1902. During these 21 years I have only registered less than 28·25 in. on three other occasions, and it is remarkable that two of them occurred within a week of this date! The dates were February 20th, 1910 (28·24 in.), February 22nd, 1914 (28·14 in.), and January 1st, 1915 (28·14 in.).

The storm continued for 48 hours and some damage was done; the daily rainfall readings were ·65 in. and ·63 in. respectively, and the floods on the River Suir were very high on the 27th and 28th. At Queenstown, Co. Cork, the barometer fell to 28·09 in., which is the lowest for 24 years.

E. W. MONTAGU MURPHY.

Ballinamona, Cashel, Co. Tipperary, March 1st, 1923.

[The *Daily Weather Report* gives the reading at 18 h. on February 6th at Birr Castle as 951 mb. (28·08 in.).—ED.*M.M.*]

Weather of recent years

THREE facts of importance have forced themselves upon my attention in late years, but they do not appear to have been much commented on. Possibly these facts have been more strongly evidenced in this part of the country than in others.

Since the cold winter of 1894-5 we have only experienced one really severe season, and that was in 1916-7, when the cold weather may be said to have endured from November to April.

The rainfall of September during the last 17 years, 1906-22, has been exceedingly short of the average. Notwithstanding the record fall in September, 1918, of 10·41 in., the average fall has been only 2·49 in., whereas Dr. Burder's average for the 37 years, 1853 to 1889, is 3·24 in.

The rainfall of December has, however, been very excessive for the last 17 years, the mean fall of the month having been 4·59 in., whereas the average is 2·88 in.

These departures from normal experience are perhaps only irregularities in our climate, though they have been extended beyond ordinary limits, and naturally call for special remark.

W. F. DENNING.

44, *Egerton Road, Bristol, February 19th*, 1923.

A Warm, Wet February

FEBRUARY, 1923 was remarkable for its warmth and wet. I have taken readings at Totland Bay for the past 37 years. This has been the warmest February and the wettest but one. The days of the month were five weeks in advance of their time, while the nights were even more forward, being as those of the last week of April, or ten weeks too warm. The sea usually reaches its coolest point about the middle of February. This year it has not been colder than 44·8° F., on February 22nd. Only once have I known more rain in February, that was with a rainfall of 5·07 in. in February 1900. This year raspberry canes were in full leaf at the middle of the month, and gooseberry

bushes in full leaf before the end. There has been an abundance of spring flowers, while the common field cowslip was in full bloom every day of the month.

The following is the summarized table for the average and the two wettest and warmest Februaries here :—

February	Max.	Min.	Rainfall	Rain Days
	° F.	° F.	in.	
1923	49·4	41·8	4·70	23
1914	48·6	41·4	3·84	18
1900	43·3	34·6	5·07	21
Average	45·2	36·6	2·11	14

JOHN DOVER.

Aston House, Totland Bay, I.O.W., March 3rd, 1923.

NOTES AND QUERIES

A Line Squall at Ross-on-Wye

MR. F. J. PARSONS reports that a line squall, accompanied by thunder and lightning, passed over Ross-on-Wye in the afternoon of February 26th, 1923. The lightning was very vivid, and the thunder heavy both before and after the passage of the squall, abating temporarily when the squall-cloud was overhead and precipitation began. The wind throughout was south-south-west, and reached force 8 or 9 (40 to 50 miles per hour) before the rain and hail started. Some damage was done both by the wind and the lightning. The squall was followed by a brilliant rainbow.

An Account of Rain Making in America

THE following despatch from the New York correspondent of *The Times* is dated February 12th, 1923 :—

> " Fogs, even ' London partiklers,' need be no more, and, given only clouds, rain can be had wherever it may be wanted, according to an announcement made last night by experimenters in the Army Air Service at Dayton, Ohio. Under the direction of Professor Bancroft, of Cornell University, and a fellow-scientist, Mr. Francis Warren, they have been making rain with sand electrically charged and dropped from aeroplanes into clouds. The results are described by observers as ' absolutely uncanny.'

The experiments have been made over a period of several months, with the primary object of dissipating fogs over flying fields. An aeroplane, moving one hundred miles an hour, 500 ft. over the tops of clouds, scattered with the propeller particles of sand charged with ten thousand volts, or about six ten-thousandths of an electric static unit, per grain. The time required to precipitate the moisture and destroy the clouds rarely exceeded ten minutes.

The clouds varied from several thousand feet to several miles in length and breadth, and the thickness from 500 ft. to 1,500 ft., and the experiments were invariably successful, though in the case of very thin clouds the moisture disappeared by evaporation before reaching the ground. According to Mr. Warren, the electric charge diminishes the surface tension of the drops of moisture, and this facilitates coalescence and condensation."

A Record Gust at Valencia Observatory

A STRONG south-easterly gale was experienced at Valencia Observatory, Cahirciveen, in the early hours of February 7th, lasting from 3 h. 30 m. to 6 h. 30 m. The average wind during that period was between 50 and 60 miles an hour, but between 4 h. 30 m. and 5 h. 30 m. many gusts of storm force (65 miles an hour and over) occurred, the maximum being 95 miles per hour at 4 h. 45 m. This is the highest gust recorded at Valencia Observatory since 1917, when the pressure tube anemometer was first installed. Between midnight and 4 h. 30 m. pressure fell 25 mb., from 980 mbs. to 955 mbs., and by 7 h. it had risen again to 962 mbs.

The gale caused considerable damage in the neighbourhood of the Observatory; all the telegraph lines were down and the wireless station out of action for an indefinite time. The Observatory itself suffered, the roof and woodwork being damaged and the greenhouse demolished.

The Conquest of the Air

DURING February several new flying "records" were established. A record climb of 20,000 feet in 12 min. 24 sec. by Flight-Lieutenant Haig at Martlesham Heath was announced in *The Times* of February 6th. The speed at ground level was 189 miles per hour.

On February 15th M. Sadi Lecointe broke the world's record for speed over a four kilometre course, at Marseilles: his average

speed for the four kilometres was 234⅔ miles per hour, beating the previous record by over 10 miles per hour. A few days later, on February 26th, another French airman, M. Maneyrol, established a record, making a motorless flight of 10 kilometres (horizontal distance) during a strong south-westerly wind near Cherbourg.

Three notable flights are also announced to take place this year. On March 15th an expedition of five French aeroplanes is to start on a world tour, probably lasting two years, with the purpose of the advancement of French aviation; and towards the end of the year an American crew will fly from Berlin to Chicago in the large Zeppelin air-cruiser now being constructed for the American Government. The third is the flight across the Pole; the latest communication from Amundsen states that he and Lieutenant Omdal intend to attempt the flight at the end of June. Successful trials have been made, and they expect to cover the 2,250 miles, Point Barrow, Alaska, to Spitzbergen, in 26 hours.

Cleaner Air for London

THE Public Control Committee of the London County Council has been considering the questions (1) how far fog in London is the result of atmospheric pollution due to preventable causes; and (2) how far the atmosphere may be improved by the larger use of electricity for power and other purposes.

The Committee has also inquired whether further powers are required to deal with the emission of smoke. It is now announced that detailed reports have been prepared and are under discussion by the Council.

Review

A DICTIONARY OF APPLIED PHYSICS. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. Vol. III. *Meteorology, Metrology, and Measuring Apparatus.* 8°, 9 × 6, pp. viii. + 840. *Illus.* Macmillan and Co. 1923. £3 3*s. net.*

Sir Richard Glazebrook retired from the position of Director of the National Physical Laboratory in 1919, but he has not been content with a life of leisure. In addition to his work as Professor of Aeronautical Science at the Imperial College of Science, he has found time for other activities, not the least important of which has been the editing of the *Dictionary of Applied Physics.* The distinctive rôle of this Dictionary is to set out the technique of the National Physical Laboratory at

the end of Sir Richard's directorship, but articles on other aspects of applied physics are contributed by authors who do not hail from the Laboratory.

The Dictionary is being published in five volumes. The third, which is devoted to Meteorology and Metrology, has recently been issued. With Metrology in general this magazine is not concerned, since the nicety of precise measurement is not of practical importance to the meteorologist. With the barometer, however, we do attempt to measure pressure to one part in 10,000, and appropriately enough this instrument is dealt with by the Metrology Department of the National Physical Laboratory. The article in the Dictionary on *Barometers and Manometers* is written by Mr. F. A. Gould from the Laboratory standpoint. It is useful to have his account of such details as the difference between the corrections to be applied to the readings of barometers of different types. That the corrections for the Kew pattern barometer should not be identical with those for the Fortin was not recognised until the development of the millibar scale directed attention to such matters, and the mathematical development of the subject has not been accessible hitherto.

The principal contributors of articles on meteorological subjects are W. H. Dines (*The Investigation of the Upper Air and Radiation*), D. Brunt (*Physics of the Atmosphere*), Sir Napier Shaw (*Thermo-dynamics of the Atmosphere*), R. Corless (*Meteorological Instruments*), C. T. R. Wilson (*Atmospheric Electricity*), F. J. W. Whipple (*Meteorological Optics*) and S. Skinner (*Humidity*). Allied sciences are represented by articles by D. J. Matthews (*Oceanography*), W. W. Coblentz (*Measurement of Solar Radiation*), E. A. Griffiths (*Radiant Heat and its Spectrum Distribution*), the late C. G. Knott (*Earthquakes and Earthquake Waves*), A. Crichton Mitchell and J. N. Shaw (*Seismometry*), and H. L. P Jolly (*Combination of Observations*).

An adequate review of a book with such a wide scope is not practicable in the space at our disposal. It may be mentioned, however, that Sir Napier Shaw's article is conspicuous as containing much new and important work not published hitherto. As is inevitable with articles from so many pens, there is a certain amount of overlapping. On the other hand there are a good many gaps, and as a mere index of meteorological terminology the *Meteorological Glossary* is to be preferred to the new Dictionary. As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war.

Obituary

Mr. John Henry James.—John Henry James was born on April 27th, 1877. He was the son of Mr. W. G. James, who joined the Meteorological Office in 1879, and is now on pension after 40 years service in the Marine Division. Mr. J. H. James accepted an appointment in the Observatories Branch in 1908. The Office was then in Victoria Street, Westminster, and after the removal to Kensington a workshop was installed for experimental work upon meteorological instruments, and Mr. J. H. James, whose mechanical ability was of a high standard, was placed in charge. In connection with the provision of special instruments and apparatus for the fighting services during the war, he was specially exempted from military service. From 1920 to his death, which occurred on February 20th, 1923, at the age of 45 years, he held the rank of Principal Assistant. Mr. James was a " Jack-of-all-trades," if that epithet may be used in a complimentary sense ; he was not only a skilful worker, but he shewed deep insight into scientific principles. Of the various instruments for the construction of which he was responsible, perhaps the twin-lever wind-direction recorder is the best illustration of his skill.

News in Brief

Two new features were introduced into the monthly flysheet (*Supplement to the Daily Weather Report*) with the issue for January, 1923. The first is a diagram shewing the daily rainfall (9h.—9h.) at Kew, the second is a summary of the observations on the state of the ground at 13h., which have, since November, 1922, been published in the *Daily Weather Report.* (See *The Met. Mag.*, Nov., 1922, p. 267).

Mr. Henry Mellish has circulated in pamphlet form an account of *The Weather of 1922 at Hodsock Priory, Worksop.* An interesting feature is the reproduction of the autographic record of the rainfall of August 6th—8th. It shows over 5 inches in a continuous fall of nearly 28 hrs., and 2 inches in 3 hrs.

The City of Nottingham issues an annual bulletin, *The Meteorology of Nottingham,* which contains, in addition to statistics, a large diagram illustrating the variation from day to day of mortality from various causes and of the principal meteorological conditions. The issue for 1922 contains, as well, a chart of the rainfall recorded at Trent Lane Pumping Station on August 6th, nearly 3·5 inches in a continuous fall of 24 hours, and 1·2 inches in 3 hours. (*Cf.* Rainfall at Hodsock Priory noted above.)

Mr. R. C. Mossman reports that on January 20th, 1923, in Buenos Aires the maximum temperature in the shade was 104° F., the highest on record for that city.

On Friday, March 2nd, Dr. G. C. Simpson, C.B.E., F.R.S., delivered a lecture at the Royal Institution on *The Water in the Atmosphere.*

Mr. A. Watters, 14, Park Avenue North, Hornsey, N. 8, has complete copies of *Symons's Monthly Meteorological Magazine* from 1906-1912, 1915, and some odd numbers, which he would be glad to sell or to exchange for volumes prior to 1903.

Meteorological Office—Staff News.—On Tuesday, March 6th, a team representing the Meteorological Office defeated a team representing the Directorate of Equipment in the first round of the "Air Ministry Inter-departmental Football Cup."

The Weather of February, 1923

THE maps of the *Daily Weather Report* for February show very little variation, a deep depression to the westward of the British Isles persisting throughout the month.

The weather generally was mild and wet. During the first four days temperature was remarkably high for the time of year. At Kew Observatory, for example, a minimum of 51° F. was recorded on three successive nights. The character of the month is well shown by the statistics of the state of the ground (see page 43). The ground was muddy for more than half the month at most places, and at Valencia, Benson and London was "wet" or "muddy" on every day. Thunder was heard in London on the 21st, and elsewhere locally on a few other occasions. Strong gales, mainly southerly, were prevalent—especially so in the north-east of Scotland; gale force was reported from Wick on no less than seventeen days. The most notable gales occurred about the 6th and 7th, and again on the 26th and 27th.

The total rainfall was in excess of the average everywhere except in the north-west of Scotland. In nearly all southern districts more than twice the average fell, and this was also the case in the east of Scotland, whilst a large area extending from the north of Cornwall to Staffordshire, and parts of the east of Scotland had more than three times their normal fall. In many places, especially in the districts last mentioned, the rainfall of the month was the highest ever known to have occurred in February, this being the case in records covering 105 years at Ross-on-Wye, 80 years at Cirencester, 70 years at Bristol and 59 years at Wolstaston, in Shropshire. The conditions appear

to have been similar to those in February, 1915, when more than three times the average occurred in western Aberdeenshire and more than twice the average fell over the greater part of the south of England and Wales. There is no doubt that February, 1923, was the wetter month of the two.

The general rainfall in the British Isles, expressed as a percentage of the average, was: England and Wales, 245; Scotland, 160; Ireland, 205; British Isles, 211.

During the month abnormally warm weather was experienced in Central Europe. The heavy falls of snow reported in the Alps during January continued until the 3rd, and the warm weather set great masses of snow in motion, causing avalanches in which several lives were lost. On the 6th there was a great landslide into the Davoser See. The melting of the snow caused heavy floods in the Danube; parts of Linz were flooded on the 3rd, and the floods reached Vienna on the 5th and Buda Pesth on the 14th, the waterworks at the latter city being flooded. In southern France, on the other hand, the beginning of the month was marked by a drought, and at Montpellier prayers for rain were offered on the 4th.

In North America the month was severe and stormy. On the 6th temperature fell to $-51°$ F. in north-west Ontario—the lowest temperature on record in that region. There was a great ice-jam on the St. Lawrence, and from the 7th to 9th, following the passage of a deep depression, a cold wave spread over the greater part of the United States. From the 14th to 16th a severe storm crossed the northern States, doing much damage and causing wrecks on the Pacific and Atlantic coasts. Very low temperatures were recorded.

An unusually heavy rainstorm visited Aden on the 14th, giving a valuable supply of water. About the same time heavy rains visited the Orange Free State, and up to the 14th the total fall for 1923 already exceeded the rainfall of the whole of 1922. There has been damage to railways and roads, but this was more than compensated by the benefit to agriculture. On the 24th heavy rains were reported from south-west Africa, flooding the Fish and Orange Rivers. On the 25th the Zambesi was in flood, interrupting railway communication.

In Brazil rainfall was heavy in the north, including the dry north-eastern region, averaging 85 mm. above normal. In central Brazil the fall averaged 36 mm. above normal, and in the south, exclusive of Rio Grande, 26 mm. above. The latter State had a deficit amounting to 42 mm. The only unusual feature of the "circulation" was the continual absence of intense high pressure systems. The coffee crop is in excellent condition. At Rio de Janeiro pressure was 2·4 mb. above normal, and temperature 0·3° F. below normal.

Rainfall Table for February, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	3·04	77	182	*Leics*	Leicester Town Hall...	3·21	81	...
Sur .	Reigate, Hartswood...	3·95	100	...	,, .	Belvoir Castle.....	3·37	85	202
Kent.	Tenterden, View Tower	3·90	99	198	*Rut* .	Ridlington.....	3·59	91	...
,, .	Folkestone, Boro. San.	...	...	...	*Linc.*	Boston, Skirbeck	3·16	80	216
,, .	Broadstairs	...	...	...	,, .	Lincoln, Sessions House	3·74	95	258
,, .	Sevenoaks, Speldhurst.	3·92	100	...	,, .	Skegness, Estate Office.	3·37	86	...
Sus .	Patching Farm.....	5·03	128	228	,, .	Louth, Westgate	4·27	109	222
,, .	Eastbourne, Wilm. Sq.	4·11	104	...	,, .	Brigg	3·40	86	198
,, .	Tottingworth Park....	4·53	115	...	*Notts.*	Worksop, Hodsock....	4·09	104	266
Hants	Totland Bay, Aston...	4·70	119	232	*Derby*	Mickleover, Clyde Ho..	4·13	105	250
,, .	Fordingbridge, Oaklnds	6·89	175	276	,, .	Buxton, Devon. Hos...	7·04	179	188
,,	Portsmouth, Vic. Park.	4·88	124	240	*Ches.*	Runcorn, Weston Pt...	4·76	121	256
,,	Ovington Rectory	7·36	187	283	,, .	Nantwich, Dorfold Hall	4·55	116	...
,, .	Grayshott	6·53	166	255	*Lancs*	Bolton, Queen's Park .	6·27	159	...
Berks	Wellington College...	4·15	105	221	,, .	Stonyhurst College....	5·47	139	163
,, .	Newbury, Greenham..	4·68	119	213	,, .	Southport, Hesketh...	3·80	97	...
Herts.	Bennington House....	3·68	94	...	,, .	Lancaster, Strathspey.	5·15	131	...
Bucks	High Wycombe	4·12	105	223	*Yorks*	Sedbergh, Akay	7·76	197	175
Oxf. .	Oxford, Mag. College..	3·35	85	212	,, .	Wath-upon-Dearne ...	4·55	116	277
Nor .	Pitsford, Sedgebrook..	4·23	107	253	,, .	Bradford, Lister Pk...	6·09	155	260
,, .	Eye, Northolm.....	2·59	66	...	,, .	Oughtershaw Hall	11·42	290	...
Beds.	Woburn, Crawley Mill.	3·04	77	208	,, .	Wetherby, Ribston H..	4·79	122	277
Cam.	Cambridge, Bot. Gdns.	2·13	54	...	*ERY*	Hull, Pearson Park ...	4·15	105	250
Essex	Chelmsford, CountyLab	2·92	74	...	,, .	Holme-on-Spalding ...	3·69	94	...
,, .	Lexden, Hill House...	3·18	81	...	,, .	Lowthorpe, The Elms.	4·00	102	221
Suff.	Hawkedon Rectory ...	2·85	72	187	*NRY*	West Witton, Ivy Ho..	6·37	162	...
,, .	Haughley House.....	2·89	73	...	,, .	Pickering, Hungate ...	4·38	111	...
Norf.	Beccles, Geldeston....	3·38	86	247	,, .	Middlesbrough	2·04	52	157
,, .	Norwich, Eaton	3·54	90	216	,, .	Baldersdale, Hury Res.	5·29	134	171
,, .	Blakeney	2·71	69	183	*Durh.*	Ushaw College	4·12	105	258
,,	Swaffham	3·78	96	241	*Nor* .	Newcastle, Town Moor.	3·47	88	219
Wilts.	Devizes, Highclere....	5·25	133	...	,, .	Bellingham Manor....	4·37	111	...
Dor .	Evershot, Melbury Ho.	9·10	231	290	,, .	Lilburn Tower Gdns...	4·80	122	271
,, .	Weymouth, Westham.	5·55	141	...	*Cumb*	Penrith, Newton Rigg..	...	...	...
,, .	Shaftesbury, Abbey Ho.	5·90	150	255	,, .	Carlisle, Scaleby Hall .	3·39	86	...
Devon	Plymouth, The Hoe...	6·90	175	238	,, .	Seathwaite	18·10	460	152
,, .	Polapit Tamar	10·11	257	315	*Glam.*	Cardiff, Ely P. Stn.....	8·79	223	293
,, .	Ashburton, Druid Ho..	12·12	308	256	,, .	Treherbert, Tynywaun	20·75	527	...
,, .	Cullompton	8·61	219	308	*Carm*	Carmarthen Friary....	8·84	225	239
,, .	Sidmouth, Sidmount ..	5·89	150	236	,, .	Llanwrda, Dolaucothy.	11·64	296	267
,,	Filleigh, Castle Hill ...	9·40	239	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
,, .	Hartland Abbey.....	7·54	191	...	*Card.*	Gogerddan.....	8·40	213	265
Corn.	Redruth, Trewirgie ...	9·17	233	242	,, .	Cardigan, County Sch. .	10·08	256	...
,, .	Penzance, Morrab Gdn.	7·55	192	226	*Brec.*	Crickhowell, Talymaes	11·25	286	...
,, .	St. Austell, Trevarna..	9·35	237	243	*Rad* .	Birm.W.W.Tyrmynydd	13·93	354	266
Som	Street, Hind Hayes ...	5·98	152	...	*Mont.*	Lake Vyrnwy	12·24	311	...
Glos. .	Clifton College	8·53	217	361	*Derb.*	Llangynhafal	3·76	95	...
,,	Cirencester	6·09	155	262	*Mer* .	Dolgelly, Bryntirion ..	13·22	336	297
Here .	Ross, County Obsy. ...	6·69	170	333	*Carn.*	Llandudno	4·54	115	218
,, .	Ledbury, Underdown.	5·66	144	...	,, .	Snowdon, L. Llydaw 9	22·40	569	...
Salop	Church Stretton.....	7·07	180	321	*Ang* .	Holyhead, Salt Island.	4·83	123	198
,, .	Shifnal, Hatton Grange	4·88	124	301	,, .	Lligwy	4·94	125	...
Staff.	Tean, The Heath Ho...	5·41	137	269	*Man.*	Douglas, Boro' Cem...	4·71	120	144
Worc.	Ombersley, Holt Lock.	4·92	125	300	*Guer.*	St. Peter Port, Grange.	6·47	164	263
,, .	Blockley, Upton Wold.	5·96	151	263	*Wigt.*	Stoneykirk, Ardwell Ho	5·87	149	224
War	Farnborough.....	4·95	126	240	,, .	Pt. William, Monreith .	5·82	148	...
,, .	Birmingham, Edgbaston	5·88	149	348	*Kirk.*	Carsphairn, Shiel.	9·11	231	...

Rainfall Table for February, 1923——*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Kirk.	Dumfries, Cargen.....	6·56	167	169	*Caith*	Loch More, Achfary...	4·58	116	69
Dum	Drumlanrig	6·25	159	164	,, ..	Wick	2·44	62	107
Roxb	Branxholme	5·37	136	204	*Ork* .	Pomona, Deerness	3·65	93	121
Selk .	Ettrick Manse.....	7·15	182	...	*Shet* .	Lerwick	4·51	115	143
Berk.	Marchmont House	4·23	107	203	*Cork.*	Caheragh Rectory	13·83	351	...
Hadd	North Berwick Res....	2·83	72	181	,, ..	Dunmanway Rectory.	12·28	312	210
Midl	Edinburgh, Roy. Obs..	2·33	59	149	,, ..	Ballinacurra	6·87	175	184
Lan .	Biggar	3.88	99	162	,, ..	Glanmire, Lota Lo.	9·18	233	232
Ayr .	Kilmarnock, Agric. C..	3·71	94	129	*Kerry*	Valencia Obsy.	...	...	...
,, .	Girvan, Pinmore.....	7·23	184	169	,, .	Gearahameen	18·80	477	...
Renf.	Glasgow, Queen's Pk..	3·82	97	130	,, .	Killarney Asylum.....	...	...	...
,, .	Greenock, Prospect H..	7·24	184	129	,, .	Darrynane Abbey	8·56	217	185
Bute.	Rothesay, Ardencr'g..	5·95	151	149	*Wat* .	Waterford, Brook Lo..	7·12	181	218
,, .	Dougarie Lodge	7·06	179	...	*Tip* .	Nenagh, Cas. Lough...	5·86	149	188
Arg .	Glen Etive.....	...	...	...	,, .	Tipperary	7·11	181	...
,, .	Oban	5·19	132	...	,, .	Cashel, Ballinamona ..	6·10	155	191
,, .	Poltalloch	5·91	150	141	*Lim* .	Foynes, Coolnanes	6·16	156	193
,, .	Inveraray Castle.....	8·08	205	119	,, .	Castleconnell Rec.	6·17	157	...
,, .	Islay, Eallabus.....	7·19	183	172	*Clare*	Inagh, Mount Callan ..	10·65	271	...
,, .	Mull, Benmore	8·60	218	...	,, .	Broadford, Hurdlest'n.	6·30	160	...
,, .	Mull, Quinish	...	...	...	*Wexf*	Gorey, Courtown Ho...	6·33	161	225
Kinc.	Loch Leven Sluice	4·61	117	163	*Kilk.*	Kilkenny Castle	6·02	153	...
Perth	Loch Dhu	10·10	257	136	*Wic* .	Rathnew, Clonmannon	7.23	184	...
,, ..	Balquhidder, Stronvar.	9·70	246	136	*Cars.*	Hacketstown Rectory .	7·06	179	235
,, ..	Crieff, Strathearn Hyd.	5·25	133	149	*QCo.*	Blandsfort House.....	5·96	151	222
,, ..	Blair Atholl.....	6·89	175	250	,,	Mountmellick	5·63	143	...
,, .	Coupar Angus School..	6·43	163	303	*KCo.*	Birr Castle.....	4·78	121	...
Forf.	Dundee, E. Necropolis.	4·85	123	258	*Dubl.*	Dublin, FitzWm. Sq...	5·78	147	306
,, .	Pearsie House.....	...	...	...	,, .	Balbriggan, Ardgillan .	5·57	141	284
,, .	Montrose, Sunnyside..	4·94	125	268	*W.M*	Athlone, Twyford.....	...	...	...
Aber.	Braemar Bank	9·82	249	360	,, .	Mullingar, Belvedere	5·68	144	204
,, .	Logie Coldstone Sch. ..	5·94	151	286	*Long*	Castle Forbes Gdns....	5·71	145	201
,, .	Aberdeen, Cranford Ho	6·35	161	274	*Gal* .	Galway, Waterdale ...	5·85	149	...
,, .	Fyvie Castle	7·70	196	...	,, .	Ballynahinch Castle ..	...	...	...
Mor .	Gordon Castle.....	4·07	103	212	,, .	Woodlawn	...	...	...
,,	Grantown-on-Spey....	2·29	58	108	*Mayo*	Crossmolina, Enniscoe	...	...	...
Na .	Nairn, Delnies.....	1·41	36	78	,, .	Blacksod Point.....	...	...	...
Inv. .	Ben Alder Lodge	8·72	221	...	,, .	Westport House.....	9·60	244	243
,, .	Kingussie, The Birches	3·25	83	...	,, .	Delphi Lodge	15·81	402	...
,, .	Fort Augustus	3·54	90	85	*Sligo*	Markree Obsy.	5·03	128	147
,, .	Loch Quoich, Loan....	8·11	206	...	*Ferm*	Enniskillen, Portora ..	5·25	133	...
,, .	Glenquoich	7·44	189	72	*Arm.*	Armagh Obsy.	5·42	138	...
,, .	Inverness, Culduthel R.	1·40	36	...	*Down*	Warrenpoint	...	...	...
,, .	Arisaig, Faire-na-Squir	2·87	73	...	,, .	Seaforde	7·95	202	261
,, .	Fort William.....	6·33	161	85	,, .	Donaghadee	5·72	145	249
,, .	Skye, Dunvegan.....	3·60	91	...	,, .	Banbridge, Milltown .	4·38	111	211
,, .	Barra, Castlebay	2·36	60	...	*Antr.*	Belfast, Cavehill Rd. ..	5·27	134	...
R&C	Alness, Ardross Cas. ..	3·95	100	120	,, .	Glenarm Castle.....	8·90	226	...
,, .	Ullapool.....	3·22	82	...	,, .	Ballymena, Harryville	4·73	120	146
,, .	Torridon, Bendamph..	5·17	131	65	*Lon* .	Londonderry, Creggan	3·57	91	112
,, .	L. Carron, Plockton...	2·60	66	...	*Tyr* .	Donaghmore	5·20	132	...
,, .	Stornoway	4·12	105	92	,, .	Omagh, Edenfel	7·84	199	263
Suth.	Dunrobin Castle.....	...	...	...	*Don* .	Malin Head	4·17	106	173
,, .	Lairg	4·87	124	...	,, .	Letterkenny Hos	5·16	131	139
,, .	Forsinard	...	...	...	,, .	Dunfanaghy	...	...	...
,, .	Tongue Manse.....	2·59	66	74	,, .	Narin, Kiltoorish	4·58	116	...
,, .	Melvich School.....	3·24	82	108	,, .	Killybegs, Rockmount.	5·80	147	116

Climatological Table for the British Empire, September, 1922

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	PRECIPITATION				BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean		Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days		
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.						Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1015·5	— 1·3	71	39	62·6	47·3	54·7	— 2·4	52·8	79	6·8	40	— 8	12	3·6	28
Gibraltar	1017·3	+ 1·5	81	57	75·2	63·7	69·5	— 2·9	63·9	75	3·9	43	+ 7	3	...	...
Malta	1015·6	— 0·1	90	66	80·5	71·1	75·8	+ 0·5	69·4	73	3·7	2	— 28	2	8·0	64
Sierra Leone	1012·8	+ 0·2	89	70	83·3	72·7	78·0	— 1·2	73·7	83	8·7	975	+250	28	...	...
Lagos, Nigeria	1011·6	— 1·2	86	72	83·4	74·4	78·9	+ 0·8	75·3	81	8·3	288	+158	24	...	...
Kaduna, Nigeria	1012·3	— 0·5	88	...	82·3	...	...	...	68·6	77	...	272	+ 12	20	...	...
Zomba, Nyasaland	1014·1	+ 0·3	90	52	81·8	59·5	70·7	+ 1·6	...	75	4·5	6	— 3	2	...	...
Salisbury, Rhodesia	1012·9	— 1·8	93	43	84·6	52·5	68·5	+ 2·3	54·4	41	1·5	1	— 7	1	...	...
Cape Town	1019·3	+ 0·2	77	42	66·2	50·2	58·2	+ 0·3	55·5	77	4·8	22	— 35	5	...	...
Johannesburg	1018·3	+ 1·1	81	35	72·0	48·5	60·3	+ 1·0	48·6	56	2·3	15	— 9	6	9·2	77
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1003·3	— 1·2	92	75	87·2	78·1	82·7	— 0·3	†78·9	†90	†8·6	544	+281	*17	...	...
Bombay	1007·1	— 0·9	87	74	84·1	76·4	80·3	— 0·4	76·0	80	6·7	189	— 86	*24	...	...
Madras	1005·4	— 1·1	99	74	95·2	78·1	86·7	+ 1·6	†76·6	†66	†4·5	48	— 83	*7	6·8	...
Colombo, Ceylon	1010·2	+ 0·6	88	74	85·6	76·7	81·1	— 0·3	76·6	70	9·0	35	— 91	13	...	...
Hong Kong	1006·5	— 1·8	91	70	85·7	76·5	81·1	+ 0·1	75·3	78	6·0	252	+ 6	15	6·8	56
Sandakan	...	...	91	72	88·3	74·5	81·4	— 0·3	...	...	...	364	+125	12	...	...
Sydney	1017·1	+ 1·1	81	46	67·2	52·1	59·7	+ 0·7	55·1	67	5·6	107	+ 33	15	6·1	51
Melbourne	1017·3	+ 1·5	76	35	61·5	44·1	52·8	— 1·3	50·3	70	5·7	64	+ 3	14	...	...
Adelaide	1017·5	0·0	84	38	66·1	47·5	56·8	— 0·2	50·3	60	4·9	41	— 9	8	5·8	49
Perth, W. Australia	1017·4	— 0·5	79	43	66·4	49·0	57·7	— 0·4	54·8	71	5·0	56	— 29	18	7·0	59
Coolgardie	1016·4	— 0·7	87	37	70·9	46·1	58·5	— 0·1	52·5	47	4·1	14	— 1	3	...	...
Brisbane	1016·5	— 0·6	82	48	73·8	54·8	64·3	— 1·0	60·5	68	3·7	85	+ 33	11	...	...
Hobart, Tasmania	1016·7	+ 6·0	67	35	58·8	43·8	51·3	+ 0·5	47·0	67	6·2	18	— 36	15	6·4	54
Wellington, N.Z.	1021·3	+ 7·8	67	33	59·0	44·8	51·9	+ 0·4	47·7	73	5·4	64	— 35	11	6·2	53
Suva, Fiji	1013·2	— 1·1	87	64	83·2	67·8	75·5	+ 1·0	74·4	83	7·5	322	+145	17	...	...
Kingston, Jamaica	1012·4	— 0·2	93	71	90·5	73·3	81·9	+ 0·4	...	78	6·3	18	— 86	7	...	...
Grenada, W.I.	1012·3	+ 0·5	88	72	85·5	75·3	80·4	+ 0·2	75·9	79	4·3	191	— 14	22	...	...
Toronto	1019·2	+ 1·4	93	35	73·6	53·4	63·5	+ 4·3	56·5	78	3·8	76	— 5	9	...	...
Winnipeg	1015·7	+ 0·9	85	32	68·1	47·1	57·6	+ 4·2	54·7	78	5·9	76	+ 26	10	...	...
St. John, N.B.	1018·6	+ 1·1	75	32	61·4	47·8	54·6	— 1·3	51·1	84	5·0	40	— 55	5	...	...
Victoria, B.C.	1016·2	— 0·3	79	46	63·9	50·3	57·1	+ 1·5	53·0	88	5·0	45	— 6	11	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Observations taken at 8 *h.* from September, 1922.